April 5, 1984

MEMORANDUM

TO: Manabu Tagomori

FROM: Joseph Kubacki

SUBJECT: Preliminary Statement Regarding Possible Impacts from Geothermal Subzone Designation on the Environment

The following are some important factors to consider when analyzing environmental impacts.

I. COMPARISON OF EXPECTED GEOTHERMAL EMISSIONS (INJECTION FLUIDS AND GASES) WITH EXISTING WORKPLACE AND AMBIENT STANDARDS

A. Emission scenarios should be constructed for 25 MW and 250 MW plants; and possibly some increments in between (Dames & Moore report considers some scenarios). Scenarios should include:

A. Rates of geothermal fluid injection. Discussion could include quality and quantity of injected fluids, means of injection, and existing water quality in expected areas of injection. (Gerald Niimi testified at the Kahaualea CDUA hearing that a 12.5 MW plant would produce about 1.6 million gallons/day of injection flud. This converts to 10 acre-feet/day/25 MW.)

B. How geothermal injection and subzoning in general will interface with applicable state groundwater standards. Department of Health's Underground Injection Control (UIC) line should be discussed with reference to how it might effect geothermal development. Also review the current status of DOH's proposed Geothermal Exempted Aquifer (GEA) program. Other federal and state water quality standards may apply to geothermal activities.

C. Expected rates of geothermal emissions into the air; especially with regard to H_2S, SO_2, H_2SO_4, trace elements of radon and mercury, and particulates. Contact developers.

1. Geothermal emissions should be contrasted with emissions naturally occurring from volcanic activity. The NEA environmental baseline survey mentioned below addresses present ambient conditions, this point. The developers also have air and water monitoring which they may share. Additionally, during the ongoing eruptions of Kilauea and Mauna Loa these have been extensively monitored for emissions. These too should be contrasted with expected geothermal activity.
2. Geothermal emissions should be compared to emissions from existing oil-fired plants in Hawaii. HECO would be a good resource.
3. Expected geothermal emissions should be analyzed to determine compliance with:

-- proposed and existing State DOH standards regarding H_2S, SO_2, and particulates.

-- any existing federal air quality standards; both OSHA workplace standards and ambient standards.
EPA

II. POSSIBLE IMPACTS ON SURFACE ENVIRONMENT FROM GEOTHERMAL DEVELOPMENT

Flora and Fauna report by UH-Manoa Environmental Center.

Lee Hannah, under Doak Cox, will identify the flora and fauna within or adjacent to most of the expected subzone areas. This might include a look at effects on surface or shallow water that might occur from geothermal development. Any rare and endangered species should be identified. (Attached is a summary of the report's objectives.)

Charles Lamourux, a UH Botanist, may also have some input into this area.

III. EFFECTS OF GEOTHERMAL EMISSIONS ON HUMAN HEALTH

A. NEA, Inc. Environmental Survey on Kilauea's East Rift Zone.

This effort was coordinated by DPED and is almost completed. Preliminary conclusions indicate:

-- Particulate levels are extremely low. Existing particulates include sea salt, dust, volcanic emissions, and organic material.

-- Sulfate and heavy metal particulates are related to volcanic emissions.

-- SO_2 from the volcanoes can exceed impact levels for days at a time, otherwise SO_2 levels are low.

-- Rain is slightly acidic due to volcanic emissions.

-- Trade wind interaction is apparent.

Generally the data from this report should be summarized and highlighted as it pertains to ~~particular~~ areas along the east rift zone.
Potential Subzone

B. DOH Health Survey.

Bruce Anderson, of the DOH, is chairman of a committee investigating the effects of H_2S on residents of Leilani Estates. The nearly completed report includes a literature review of the effects of high-level and low-level exposure to H_2S. Information has been gathered from residents by a door-to-door survey. Any conclusions regarding ~~the~~ toxicity of H_2S should be drawn from this report.

C. "Puna Speaks" Trial.

Some information regarding resident complaints may be drawn from the "Puna Speaks" testimony, where many local residents complained of maladies from geothermal emissions. Judge Fong's decision held that residents did not prove harmful effects resulting from HGP-A's emissions.

D. Kapoho #1 Well Blow-Out.

In October, 1982, this well leaked unabated for 33 hours. Thermal Power had six nearby resident water tanks checked for contamination and found none. ~~Since this information is extremely important residents might be contacted to determine the amounts of noise during the leak.~~

E. UH Study on Molds and Fungi in Puna.

This UH survey (July, 1982) concluded that area molds and fungi were largely responsible for some ailments which residents attributed to emissions from HGP-A.

F. Threshold levels relating to geothermal emissions.

The DOH survey-report contains some threshold levels regarding H_2S. Other threshold levels regarding SO_2, mercury, radon, and other goethermal emissions should be investigated and compared to existing emissions from the volcanoes and HGP-A and expected emissions from future geothermal developments.

IV. AMBIENT SMELL ASSOCIATED WITH H_2S AND GEOTHERMAL DEVELOPMENT

A. Threshold levels.

Threshold levels for the nuisance "rotten-egg" smell should be investigated. DOH could be source, as well as the New Zealand study mentioned below.

These odor levels should be compared to existing levels from volcanic sources, HGP-A, and expected emissions from commercial development. This information can be ~~very~~ useful as a factor in plant siting to minimize ~~smell~~ impact on the resident population. abatement requirements and

B. The New Zealand H_2S and health study.

This capsule of New Zealand's geothermal experience may be of some use. Generally, Rotorua, NZ uses geothermal energy extensively for space heat, hot water, tourism, disease treatment, and electricity. No adverse health effects were noted but the "rotten egg" small of H_2S was evident. It should be recognized that expected smells from developments in Hawaii should be less; since Rotorua's abatement systms are quite minimal and do not compare with the systems at HGP-A and

those recommended by Dames & Moore. More precise information regarding abatement should be sought from the developers

V. AESTHETIC ENVIRONMENTAL EFFECTS

Aesthetics is an important consideration when constructing power plants and transmission lines; whether the source is geothermal, oil-fired, or otherwise. Aesthetics can be preserved by careful siting, tasteful design, and landscaping. Ideas regarding camouflaging a geothermal power plant (e.g. through tree plantings and painting) were discussed by Ed Williams, a landscape architect, at the Kahaualea CDUA hearing. Similar techniques are available with respect to power lines. They can be aesthetically designed, painted, or even placed underground. However, additional cost must be considered.

VI. NOISE IMPACTS

A summary and assessment of noise threshhold levels should be given; similar to those in attached figure 20.

These should be matched against actual noise levels from geothermal drilling, venting, construction, maintenance, and operations. This information may be a useful factor in determining abatement requirements and possibly ~~site selection~~ subzone location.

These noises should be compared to noise from oil-fired plants, airports, and volcanic activity.

ENVIRONMENTAL RESOURCE PEOPLE

The Developers--Thermal Power, Barnwell, True-Mid-Pacific
DLNR--Division of Water and Land Development
DPED--Energy Division
DOH--Environmental Section (645 Halekauwila St.)
- Bryan Choy, water standards
- George Fujimoto, air standards
- Bruce Anderson (Punchbowl St.) (DOH Survey)

UH--
- Doak Cox - Botany
- Lee Hannah - Botany, Fauna
- Charles Lamoureaux - Botanist
- Sanford Seigal - Environmental Quality
- Andrew Berger - Bird Specialist
- Mark Collins - Bird Specialist
- P. Anders Daniels - Energy & Air Pollution
- Don Thomas - Environment generally

Maili Stemmerman - Audubon Society
Lou Lopez - Abatement and Waste Disposal Specialist (Consultant)
James Morrow - Air Pollution Specialist (American Lung Assoc.)
Richard O'Connel - Air Pollution Specialist (HECO)

REFERENCES (in addition to those mentioned above)

EIS Statements for HGP-A and Kahaualea
Geothermal Power Development in Hawaii, Vol. I & II
Geothermal Energy for Hawaii
Computerized Bibliography - some suggested key words:
AIR, AQUIFER, ATMOSPHERE, BASELINE, CONDITIONS, DESIGN, DEVELOPMENT, DISCHARGE, DISPOSAL, EFFECT, EMISSION, ENVIRONMENTAL, EVALUATION, GAS, GROUND WATER, HGP-A, HILO-PUNA, IMPACT, MERCURY, MODELLING, NATURAL EMISSIONS, NATURAL WATERS, PLANTS, POLLUTION, TOXIC, WATER. RADON, SULFUR,

Testimony from Kahaualea CDUA hearing

CONCLUSIONS

Conclusions should suggest whether an environmental factor should receive primary consideration prior to subzone designation or prior to granting a development permit (CDUP or SUP).

The geothemal amendments now being considered by the legislature should be followed to determine where primary control of development lies.

Environmental effects and ~~possible~~ locations of alternative oil-fired plants should be ~~stressed~~ fully considered when weighing the environmental costs and benefits. Similarly, it should be noted whether expected geothermal emissions would be significant in comparison to naturally occurring volcanic emissions.